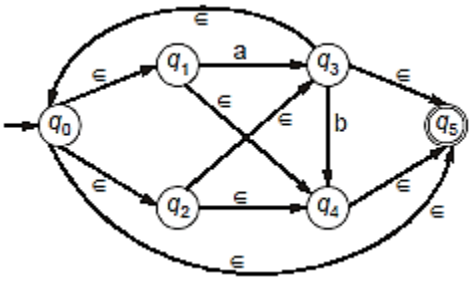
THEORY OF COMPUTATION

1. Consider the following NFA.

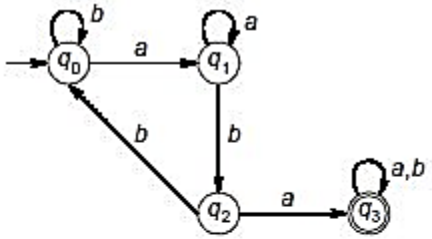


Find the epsilon closure of state q_2.

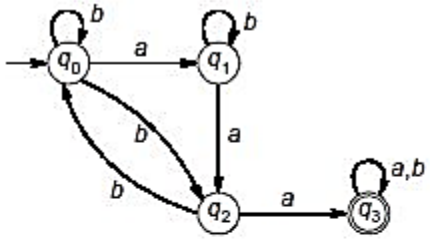
(a) $\{q_4, q_3, q_5\}$ only
(b) $\{q_3, q_4\}$ only
(c) $\{q_0, q_5\}$ only
(d) $\{q_0, q_1, q_2, q_3, q_4, q_5\}$

2. Let L be a language defined as L = {w | w contain 'aba' as substring, w ∈ (a + b)*}. Which of the following DFA will recognize the language L?

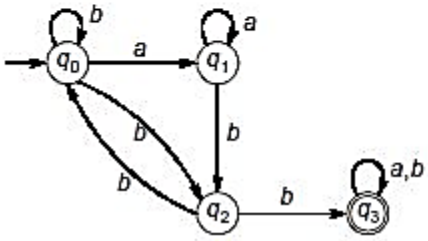
(a)



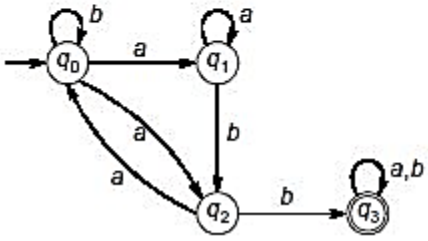
(c)



(b)



(d)



3. Consider the following DFA.

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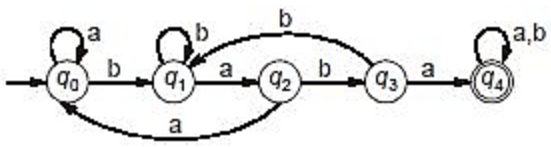
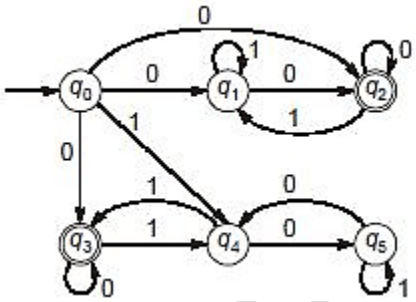


Which of the following will represent the complement of the language generated by above DFA?

(a) L = {w | w contain abab}
(b) L = {w | w contain baba}
(c) L = {w | w does not contain baba}
(d) L = {w | w does not contain abab}

4. Consider the following NFA.



The above NFA accepts all those binary strings which represents the decimal numbers and are

(a) divisible by 6 only
(b) divisible by 2 and 3 only
(c) divisible by 2 or 3
(d) None of these

5. Which of the following statements are True?

S1: Every left recursive grammar can be converted to right recursive grammar and vice-versa.
S2: All ∈-productions can be removed from any context free grammar.
S3: An unambiguous context free grammar always has a unique parse tree for each string of the language generated by it.

(a) Only S1 and S2
(b) Only S1 and S3
(c) Only S2 and S3
(d) S1, S2 and S3

6. Which one of the following regular expression over {0, 1} denotes the set of strings which do not contain 101 as a substring?

(a) 1*(1+0)*
(b) 1*(01+0)*
(c) 10*10
(d) $0^*(1 + (00)^+)^*0^*$

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7. If string of length 10 is used to test for membership, then the number of table entries in CYK algorithm is

(a) 50 (b) 55
(c) 45 (d) 99

8. Let <M> be the encoding of turing machine as a string over $\Sigma = \{0, 1\}$. Let L = {<M> | M is TM on input w will visit some state P}.

The language L is

(a) Decidable
(b) Undecidable but partially decidable
(c) Undecidable and not even partially decidable
(d) Not a decision problem

9. Let $L \leq_M L'$ denote the language L is mapping reducible (many to one reducible) to language L'. Which one of the following is True?

(a) If $L \leq_p L'$ and L' is semidecidable then L is semidecidable.
(b) If $L \leq_p L'$ and L is RE then L' is RE.
(c) If $L \leq_p L'$ and L is decidable then L' decidable.
(d) If $L \leq_p L'$ and L is recursive.

10. Let L be the language containing only the string S where

$$S = \begin{cases} 0 & \text{If you will never clear the gate} \\ 1 & \text{If you will clear the gate some day} \end{cases}$$

Which of the following is true? (L' is the Complement of language L)

(a) L is decidable (b) L' is decidable
(c) L and L' both are decidable (d) L is undecidable

11. In the minimal finite automata accepting the set of all strings over {a, b} where the number of a's and the number of b's is divisible by 4 the total number of non-final states are _____.

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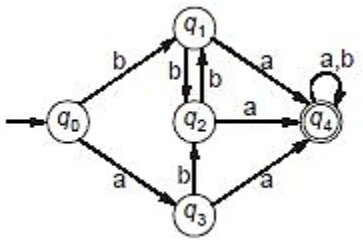
12. Consider the following DFA D.



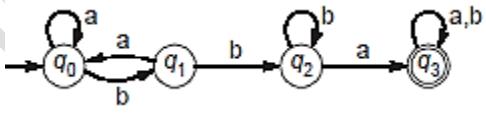
The number of states in the minimization of D is _____.

13. Let w be any string of length 5 in (0 + 1)*. Let L be the set of all substrings of w. The minimum number of states in non-deterministic finite automaton that accept L is _____.

14. If G is a context free grammar and w is a string of length 10 in L(G). The length of derivation of w in G, if G is in Chomsky normal form is _____.

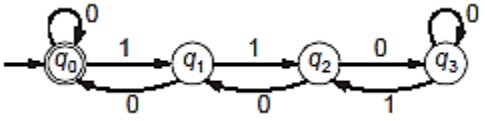
15. Number of states in the minimized DFA that accepts all strings over alphabet Σ = {0, 1} in which number of 0's is divisible by 8 or number of 0's is divisible by 16 is _____.

16. Consider the following DFA.



The number of strings op upto length 5 where first and last character of string is 'a' are _____.

17. Consider the following FA



Which of the following string is accepted by above FA?

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(a) 0110
(b) 00110
(c) 000111
(d) 0001100

18. Which of the following is True?

(a) Complement of CSL is CSL
(b) Complement of CFL is CFL
(c) Complement of RE is RE
(d) Complement of non-CFL can't be CFL

19. Consider the following statements:

S1: Infinite language with finite dependency is always regular.
S2: Regular expression 01*0 represents an infinite set of finite strings.

Which of the following is True about S1 and S2?

(a) only S1 is True
(b) only S2 is True
(c) both S1 and S2 are True
(d) both S1 and S2 False

20. Consider the following

S1: Pumping lemma is used to prove, that particular language is not regular
S2: For all DCFL there exist LR(k) grammar but LL(k) may not exist.

Which of the above statements are true?

(a) Only S1
(b) Only S2
(c) Only S1 and S2
(d) None of these

21. Consider the following statements:

1. The complement of every turing recognizable language is turing recognizable.
2. Deciding if a given string is generated by a given context free grammar is decidable.

Which of the above statements are correct?

(a) Only 1
(b) Both 1 and 2
(c) Only 2
(d) Neither 1 nor 2

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22. Consider the following language L = {w ∈ (a+b)* | w has atleast as many occurrences of (bba)'s as (abb)'s}. Which of the following statements is/are true?

S1: Language L is regular.
S2: Complement of L is CFL.
S3: Complement of L is CSL.
S4: Reversal of L is CFL.

(a) Only S1
(b) Only S2 and S4
(c) Only S1 and S3
(d) All of these

23. Consider the following grammar G.

G: $S \rightarrow XC \mid AY$
$X \rightarrow aXb \mid \in$
$C \rightarrow cC \mid c$
$A \rightarrow aA \mid a$
$Y \rightarrow bYc \mid \in$

Which of the following is correct?

(a) G is ambiguous but L(G) is not inherently ambiguous
(b) G is ambiguous but L(G) is inherently ambiguous
(c) G is not ambiguous but L(G) is not inherently ambiguous
(d) None of the above

24. Consider the language

$$L_1 = \{0^n1^n2^m \ln, m \geq 0\} \text{ and } L_2 = \{0^n1^m2^m \ln, m > 0\}$$

Which of the following statements is True? (L^c is the compliment of L)

(a) $L_1 \cap L_2$ is CSL
(b) $L_1 \cap L_2$ is CFL
(c) $L_1^c L_2^c$ is CFL
(d) None of these

25. Consider the following context free grammar G:

G: $R \rightarrow XRX \mid S$
$S \rightarrow aAb \mid bAa$
$A \rightarrow XAX \mid X \mid \in$

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$X \rightarrow a \mid b$

Which of the following correctly describes the above grammar G?

(a) L(G) contain all strings over 'a' and 'b' that are palindrome only
(b) L(G) contain all strings over 'a' and 'b' that are not palindrome
(c) L(G) contain all strings with equal number of 'a' and 'b' only
(d) None of the above

26. Consider the following statements:

S1: Turing machine can write the blank symbol □ on its tape
S2: Tape alphabet Γ can be same as input alphabet Σ
S3: Turing machine's head can ever be in the same location in two successive steps
S4: Turing machine contain only single state

Which of the above statements are correct?

(a) S1 and S2 only
(b) S1 and S3 only
(c) S2 and S4 only
(d) S1 and S4 only

27. Find the minimum number of states in the DFA which accept the language of all strings that begin or end with 00 or 11.

(a) 6
(b) 7
(c) 8
(d) 9

28. How many states are present in minimal DFA that accept all the strings of the regular expression b*a(a+b)*?

(a) 2
(b) 1
(c) 4
(d) 5

29. Let L be the language represented by the regular expression Σ*abbΣ* where Σ = (a + b). What is the minimum number of states in FA that recognize L?

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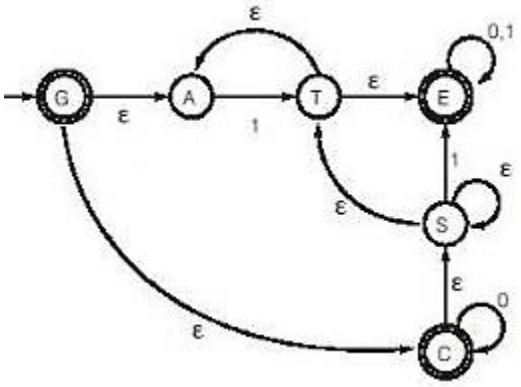
30. Let $L_1 = a^*b^*$ and $L_2 = \{ab\}$. L_3 = Prefix $(L_1^* \cap L_2)$, where prefix (L) = {uluv ∈ L for any v}. The number of strings in L_3 is _____.

31. Consider the following regular expression R = a*b* + b*a*. The number of equivalence classes of Σ* to represent a language which is equivalent to R is _____.

32. Consider the following ∈-NFA.



The number of states required to construct an equivalent minimized DFA for the given ∈-NFA is _____.

33. Consider the following CFG.

$$S \rightarrow aSa \mid bSb \mid a \mid b \mid \in$$

For the above CFG, the total number of strings generated whose length is less than or equal to 8 [exclude the empty string] is _____.

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